the properties of these polygons and shows how, by their use, the shearing and bending actions, lines of resistance, &c., due to given loads may be determined. The drawing of link polygons so as to lie within given loaded arch rings is explained, and applied to the determination of the so-called line of least resistance of a masonry arch. The deflections of beams are next considered, and the link polygon method is extended and applied to the plotting of the elastic curves of loaded beams, including continuous beams. The latter were treated in vol. i. by the aid of the theorem of three moments. The student has thus the advantage of a comparison of the two methods.

Nearly a fourth part of the text is thus occupied in establishing the fundamental properties of the link and vector polygons, and then the author, in the second part, which comprises the remainder of the work, and is divided into three sections, proceeds to the practical applications.

Section i. deals with the stability and design of tall chimneys, buttresses, and various forms of cranes.

In Section ii. the subject of earth pressure is very fully considered, and examples are given of the design of retaining walls to resist the pressure of earth, and of masonry dams for reservoirs.

"Structures that span an interval" is the heading to the concluding Section iii.; and here the author treats very fully of masonry arches, fixed and continuous girders, cantilever bridges, stiffened suspension bridges, hinged metal arches, &c.

In an appendix a partial reprint is given of a paper by Colonel A. Cunningham on well foundations, which should prove of special interest to students and engineers in India, where, in spanning many of the rivers, the foundations have to be laid in quicksand.

It seems an unfortunate omission that in so excellent a treatise no reference is made to the application of the strain-energy method and the principle of least work to calculations on the deflections and stresses in braced frames, structures with redundant members, arched ribs, &c.; but otherwise the treatment is quite up to date. As regards practical construction, information is given as to the design of many details; and some examples of complete designs are fully worked out, and illustrated by drawings, taken principally, by permission, from Colonels Wray and Seddon's "Instruction in Construction." There are numerous folding plates, facilitating reference and allowing the figures to be drawn to a large scale.

The treatise can be recommended as a useful book of reference for engineers in the pursuit of their profession. Students who master the details of both volumes should, in the subjects of which they treat, be well equipped for their duties of after life.

OUR BOOK SHELF.

Ordnance Survey of England and Wales. Scale 4 miles to 1 inch, or 1 : 253,440. Sheet iv. Price 1*s.* 6*d.*

THIS sheet is a specimen of the new quarter-inch map of the British Isles which is being issued by the Ordnance Survey at Southampton, and we have pleasure in recognising in it many marks of the vitality of the Survey and of its power of employing the most modern methods to meet new requirements. The old quarter-inch map of Ireland in four huge sheets was a masterpiece of engraving and of printing directly from the plate; the old quarter-inch map of Scotland was a somewhat hapless attempt to show rivers in blue on an outline very sketchily printed from transfers in black, while the old quarter-inch map of England was a clear outline with fine lettering but little detail, the antiquity of which was thrown into painful relief by the insertion of railways up to a modern date. The new quarter-inch map of Great Britain, now in course of publication, is up to date in all particulars, and beautiful as well as accurate. The sheets are of convenient size (24 in. × 16 in.), the edges graduated to single minutes of latitude and longitude, with the meridians and parallels for each 20′ drawn clearly across the map, thus greatly facilitating the plotting of any distribution which has been worked out on maps of a larger scale, an advantage which will appeal to every geographical worker. The names and general detail are printed in black, the size of the lettering nicely graduated to show relative importance, and the style of execution is worthy of the best traditions of the old one-inch map. Railways are shown in a strong black line, county boundaries in a distinct dotted line, and roads of three classes are distinguished, the first class having the usual indication as to fencing and being coloured solid brown. Rivers and other water surfaces are given in blue, and when the altitudes marked on in bold black figures are considered the surface would appear to be so fully occupied that nothing could be added. Here, however, the chief novelty and beauty of the map appears. The configuration of the country is shown by a hill shading so expressive and unobtrusive that it actually seems to make more room for the other features, by throwing each into its own proper place and fixing it there. The blue threads of the water-courses accentuate the valleys of the high moorlands, the roads and railways are fitted with a pictorial commentary explanatory of every curve; even the county boundaries, so arbitrary on common maps, are seen to be natural lines, now a main watershed, again a powerful river. Colonel Johnston deserves the utmost credit for his bold and successful experiment in expressing relief without the use of contours or of hachures by the half-tone photographic reproduction of washes of colour. The hill-work is printed in brown, with which the blue of the water and the black of the names and railways contrast equally, and even the green with which extensive woodlands are shown stands out well.

The technical production leaves nothing to be desired, and we confidently place this map before any other in the world on the same scale for beauty of finish, accuracy of execution and sound judgment in the selection of features and names. It will be invaluable for mapping the distribution of phenomena in many branches of science, and welcome also to the tourist and motorist.

A Manual of Elementary Practical Physics. By Julius Hortvet, B.S. Second edition. (Minneapolis: H. W. Wilson, 1902.)

"LIFE is not long enough to admit of a *rediscovery* of the fundamental laws of physics. Besides . . . some of the laws were not discovered through experiment at all, but, on the contrary, were obtained by pure reasoning and afterwards verified by experiment."

This quotation will show that the author is not an adherent of the out-and-out heuristic school. But while it is not expected that a pupil shall go through the necessarily slow process of acquiring *all* his knowledge by his own investigations, he is expected to think for himself while the chain of reasoning to be followed and the conclusions to be drawn are indicated by questions which the pupil has to answer. While in sympathy, in the main, with this method, we do not think that the questions are always very happily chosen. Thus after experiments on the bending of a lath and the stretching

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of a spiral spring occur the following:—"What quantities included among the above results are stresses and what are strains? State the relation between the elongation of the spiral and the stretching force. Does it appear that the elasticity of the spiral is perfect? State the relation between the force of elasticity and the elongation; also the relation between the elasticity of the spiral and the stretching force. State the relation between the strain and the stress."

We like better the instruction given in regard to the performance of the selected experiments, much of which appears excellent and should prove very useful to the teacher. It is a school-book, and we therefore notice with pleasure an adequate paragraph on "significant figures" and another on the plotting of curves. The book, although a second edition, is by no means free from mistakes and obscurities, some of which will be briefly mentioned. The standard metre is not the one preserved in the Archives of Paris, but one of those at the International Bureau at Sèvres. In connection with the barometer, "The same rise in temperature has caused the metal scale and tube to expand so that the observed height is too small." The expansion of the tube does not matter. On p. 136 we find, "Heat is a physical quantity in the same sense that force is a quantity," while on p. 73 it is stated that "force is not in itself a physical entity." In the former, did the author mean "energy" instead of force? The signs in the formulæ for lenses on p. 185 are very confused. "It is important that the principal axis of the lens should lie parallel with the line joining the centres of object and image, and be as near to that line as possible" (p. 186). Page 193, explanatory of electric capacity, is bad; while in the same chapter the phrase "touch B to bring its charge to zero" occurs twice, when potential, not charge, is meant. Lines of magnetic force are said on p. 197 to form closed circuits through a magnet, although such a line has been defined as giving the direction in which a north pole would be urged.

Such statements as these will mislead a teacher who is not very clear himself, and work the usual havoc. But a good man will receive a large number of useful hints from the book, and to such we commend it.

A. W. P.

The Journal of the Iron and Steel Institute General Index. Vols. xxxvi.–lviii., 1890–1900. Edited by Bennett H. Brough, Secretary. Pp. 511. (London: E. and F. N. Spon, Ltd., 1902.)

IT is impossible to over-estimate the value of collective indexes to the transactions of scientific societies as an aid to research. The new general index to the twenty-three octavo volumes of the *Journal* of the Iron and Steel Institute published during the years 1890 to 1900 inclusive is of special value, inasmuch as it contains references, not only to the authors and subjects of papers contributed to the Institute, but also to those of papers relating to iron and steel and cognate subjects published in other journals at home and abroad of which abstracts have been printed by the Institute. These abstracts are systematically arranged and constitute a valuable feature of the Institute's *Journal*. They indicate the great amount of activity at present exhibited in research and investigation connected with iron and steel. In 1900 no less than 1507 papers dealing with iron and steel, written in various languages, were abstracted. The general index furnishes, therefore, a useful means of reference to the whole field of recent literature of iron and steel. The volume also contains an interesting introduction tracing the history of the development of the Institute. From its foundation in 1869 to the end of 1900 it had published 581 original memoirs, and its *Journal* had covered 29,105 pages, with 1124 plates. This introduction is illustrated by full-page portraits of the sixteen past presidents, the seventh Duke of Devonshire, Sir H. Bessemer, Sir Lowthian Bell, W. Menelaus, Sir W. Siemens, E. Williams, J. T. Smith, Sir B. Samuelson, Dr. Percy, D. Adamson, Sir J. Kitson, Sir F. A. Abel, E. Windsor Richards, Sir David Dale, E. P. Martin and Sir W. Roberts-Austen.

Zur Metaphysik des Tragischer. By L. Ziegler. Pp. ix + 104. (Leipzig: Dürr'schen Buchhandlung.) Price Mk. 1·60.

A PLEASANTLY written little pamphlet on the spirit of tragedy and its philosophical implications. Mr. Ziegler's main contention is that the object of tragedy is to exhibit the absolute domination of the whole personality of the tragic hero by a single impulse or purpose. The tragic catastrophe affords, as it were, an ocular demonstration of the "illogicality" or "guilt" of any finite purpose which sets itself up against the totality of the world-process. This thought is then affiliated by the writer to the central idea of von Hartmann's doctrine of the unconscious, the "redemption" of the "cosmos" from itself. As in duty bound, Mr. Ziegler exhibits all the intellectual prejudices of the sentimental-romantic school to which he belongs. He is, of course, anti-semitic, and is quite sure that "we Germans" are the metaphysical salt of a degenerate world. Also he prefers Richard Wagner to Shakespeare as an exponent of the tragic idea. From his somewhat sentimental point of view he has some interesting criticisms of ancient and modern tragedy. This is not the place to discuss his theory in detail, but one question may perhaps be put to him. On his view, so long as the tragic hero wills something passionately, it must be a matter of indifference what he wills. Richard III. or, for the matter of that, Bluebeard is as good a hero as Antigone or Othello. Now does not this position, to say the least of it, require some substantiation? With more reverent study of the great masters of tragedy and less rhetoric about the defects of the Jews and the superhuman excellences of the German genius, he may in future make a more valuable contribution to æsthetic theory.

A. E. T.

Hygiene for Students. By Edward F. Willoughby, M.D.Lond. Pp. xx + 563. (London: Macmillan and Co., 1901.) Price 4*s*. 6*d*.

THIS book, which is a fourth edition of the "Principles of Hygiene," although designed for the examinations of the Board of Education, covers a wide field, and should be of considerable value to medical practitioners and others who wish to gain a general knowledge of, without going deeply into, the subject. An excellent account is given of various dietetic substances, wines, tea, coffee, bread, meat, butter, &c., their actions, uses and adulterations. Some good advice is given respecting sleep and its attainment, but the suggestion that 5–10 grains of chloral may be taken in extreme cases of insomnia is decidedly one that should have been omitted. Ventilation and heating are dealt with more fully than is usual in books of the size; and there is a good account of drainage and sanitary appliances. Chemical methods for the disposal of sewage are condemned, while a concise account of the various bacterial systems is given. The author adopts a classification of his own of the specific infective diseases, which has many points to recommend it; and the information given seems to be well up to date, *e.g.* the transmission of malaria and of yellow fever by the mosquito. Altogether, the book is one which may be recommended, not only to the beginner, but also to the advanced student, for much information is introduced which is usually only met with in the larger text-books.

R. T. H.

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